

A New Combination and a New Variety of *Musa itinerans* (Musaceae)

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Musa itinerans Cheesman (Musaceae) is a highly polymorphic species, dispersed across continental Southeast Asia from Northeast India to Vietnam and the adjacent islands, with six previously described varieties viz. var. *annamica*, var. *chinensis*, var. *guangdongensis*, var. *itinerans*, var. *lechangensis*, var. *xishuangbannaensis*. This work is a continuation of the earlier study from the mainland of China and it is extended to the islands of Hainan and Taiwan. A new combination *Musa itinerans* var. *formosana* is proposed and *M. itinerans* var. *hainanensis* is described as new. A table and key for the distinguishing characteristics are provided. These studies are based on morphological characteristics observed in the field, in various herbaria as well as the literature on Musaceae.

Key words: China, Hainan, *Musa itinerans*, *Musa itinerans* var. *formosana*, *Musa itinerans* var. *hainanensis*, Musaceae, Taiwan, wild banana

The genus *Musa* L. (Linnaeus 1753) belongs to the family Musaceae, which includes two other genera, *Ensete* Horan. (Horaninow 1862) and *Musella* (Franch.) C. Y. Wu (Franchet 1889, Wu, 1978). The type species of the genus is *Musa paradisiaca* L. and the first scientific term given to banana is *Musa paradisiaca* L. (1753). *Musa seminifera* was described by Loureiro (1790) and later combined with *M. paradisiaca* as a subspecies by Baker (1893). Warburg (Schumann 1900) described var. *formosana* of *Musa paradisiaca* subsp. *seminifera* (Lour.) Baker. Hayata (1917) considered it as a species *Musa formosana* followed by Kao & Lai (1978). Ying (1985, 2000) transferred it to *Musa basjoo* as var. *formosana* followed as renaming *Musa formosana* Wu & Kress (2000) and Chiu *et al.* (2004).

Musa itinerans was described by Cheesman (1949) based on plants grown in Trinidad from seeds from upper Myanmar (Burma). Simmonds

further issued some critical notes on the species from India and Thailand, based on his banana collecting expedition to Southeast Asia in 1954–55, but he never visited Myanmar and his observations were based on species from India and Thailand (Simmonds 1956a, 1956b, 1960). Valmayor *et al.* (2005) described *Musa itinerans* subsp. *annamica* from North Vietnam, but it has later been treated as a variety of *Musa itinerans*, based on further studies in China (Häkkinen *et al.* 2008). Häkkinen *et al.* (2008) described six varieties of *M. itinerans*, viz. var. *annamica*, var. *chinensis*, var. *guangdongensis*, var. *itinerans*, var. *lechangensis*, var. *xishuangbannaensis* based on extensive studies in China. In the present study the islands of Hainan and Taiwan were investigated and the Taiwanese variety is combined with *Musa itinerans*, and a taxon from Hainan is described as a new variety (Wu 1977, Liu *et al.* 2007). Several other *Musa itinerans* varieties

grow still in Vietnam, Thailand, Laos, Myanmar and India, but these taxa are subjects for further study (Anderson 1993, Häkkinen pers. obs.).

Materials and Methods

This paper is based on extensive field observations made by the authors during expeditions in 2005, 2006 and 2007 to China, including the islands of Hainan and Taiwan. Later on the first author extended the studies to Vietnam in 2008. The new combination and variety are described

from living plants in the field by completing the International Network for the Improvement of banana and plantain (INIBAP) *Musa* Descriptor List (IPGRI-INIBAP/CIRAD, 1996). The descriptive terms herein agree with those of the traditional banana taxonomy (Simmonds 1962, 1966). Relevant portions of the plant specimens were deposited as holotypes at the Herbaria of the South China Botanical Garden (IBSC), with isotypes at H, MO and paratypes at National Pingtung University of Science and Technology (PPI).

TABLE 1. The main diagnostic characters of the *Musa itinerans* and its two varieties

| | var. <i>itinerans</i> | var. <i>formosana</i> | var. <i>hainanensis</i> |
|---|---|--|--|
| Plant height | to 5 m | to 2 m | to 4 m |
| Rhizome length | 2 m from parent plant | 0.3–1 m from parent plant | 0.5–2 m from parent plant |
| Number of suckers | to 4 (rhizomatous) | to 10 (rhizomatous) | to 5 (rhizomatous) |
| Leaf habit | normal (intermediate) | normal (intermediate) | normal (erect) |
| Underlying color of the pseudostem | green | light-yellowish | light-green |
| Pigmentation of the underlying pseudostem | red-brown | red-brown | large black blotches |
| Sap color | watery milky | watery | milky |
| Petiole margins | erect | erect | margins |
| Leaf size | 300 × 60 cm | 130 × 30 cm | 250 × 50 cm |
| Colour of leaf upper surface | dark green | green | dark green |
| Peduncle colour | green to black | pale green to rusty brown | green to rusty brown |
| Basal flowers | female 14 in two rows on average | hermaphrodite 8–12 in two rows | female 15 in two rows on average |
| Male bud shape and size | ovoid 16 × 9 cm | ovoid 13 × 7 cm | ovoid 12 × 7 cm |
| Color of the bract external face | dark purple with yellow margin | red with green margin and yellow stripes | pale yellow tinted with green |
| Male bract lifting | lifting one bract at a time, revolute | lifting one or two at time, revolute | lifting two bract at a time, revolute |
| Flowers per bract | 12 in two rows on average | 12–17 in two rows | 17 in two rows on average |
| Number of fruits | 4 hands, 13 fruits per hand on average | 5–9 hands, 8–12 fruits per hand on average | 9 hands, 15 fruits per hand in 2 rows on average |
| Fruit size and shape | 10 cm long, slightly curved and pronounced ridged | 7 cm long, straight and ridged | 6.5 cm long, rounded |
| Pedicel | 3.5 cm long, pubescent | 3 cm long, pubescent | 4.5 cm long, pubescent |
| Immature fruit peel color | pale green | whitish green with red or violet | pale green |
| Fruit peel colour at maturity | pale yellow | dull brown-yellow | dull black |
| Fruit at maturity | not splitting | not splitting | splitting in length wise |

Field key to the varieties of *Musa itinerans*

- 1a. Basal flowers hermaphrodite
 - 2a. Male flowers 12–17 in two rows..... var. **formosana**
 - 2b. Male flowers 10 in one row var. *xishuangbannaensis*
- 1b. Basal flowers female
 - 3a. Male flowers in one row var. *annamica*
 - 3b. Male flowers in two rows
 - 4a. Peduncle glabrous var. *lechangensis*
 - 4b. Peduncle puberulent with short or long hairs
 - 5a. Petiole with erect margins
 - 6a. Female bract dark purple with yellow margin..... var. *itinerans*
 - 6b. Female bract red-purple with paler pinkish lines..... var. *guangdongensis*
 - 5b. Petiole not with erect margins
 - 7a. Male bud pale red-purple with a yellow margin..... var. *chinensis*
 - 7b. Male bud pale yellow..... var. **hainanensis**

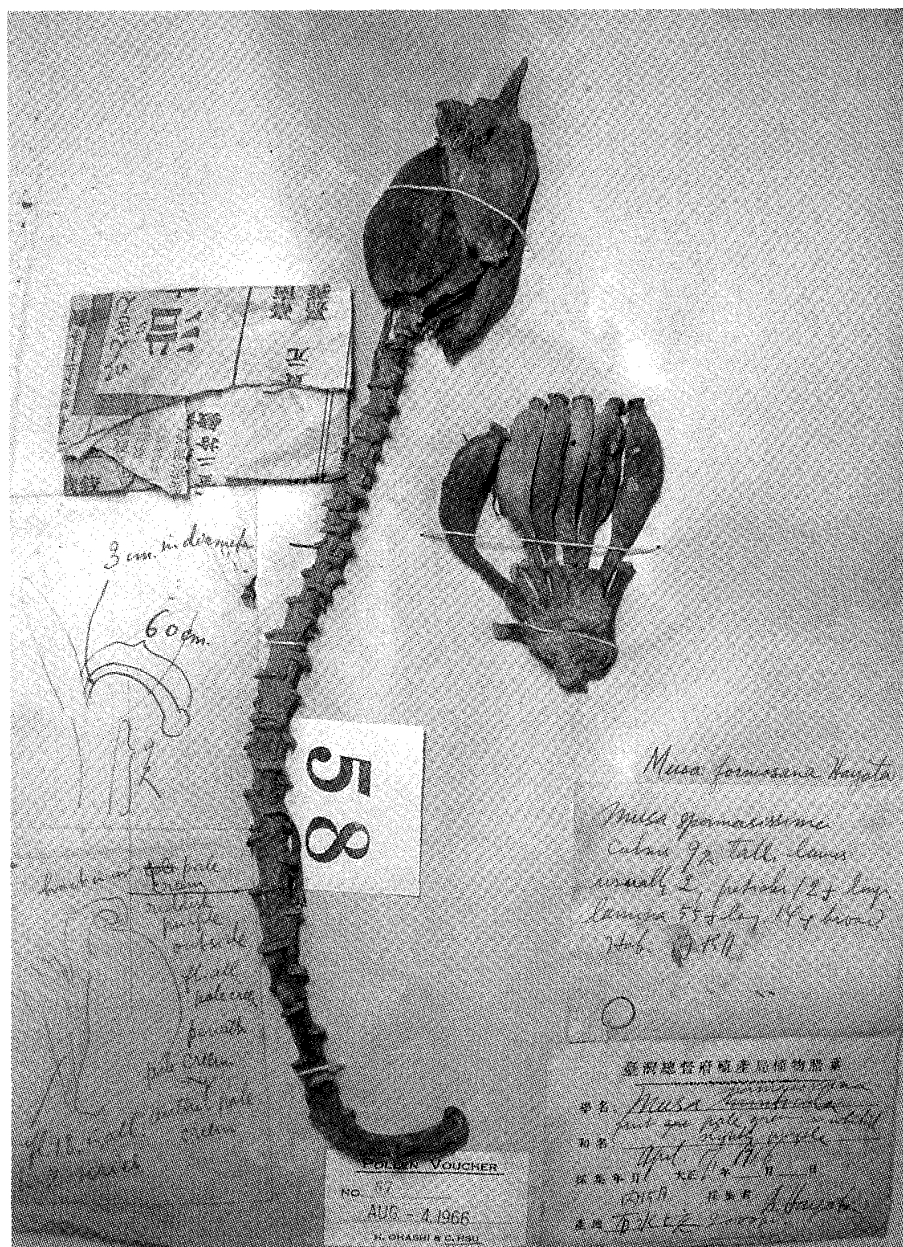


FIG. 1. *Musa itinerans* var. *formosana* (Hayata) Häkkinen & C. L. Yeh. Neotype, B. Hayata s.n. (TI). Photo by Akiko Shimizu.

***Musa itinerans* Cheesman**

Musa itinerans Cheesman, Kew Bull. 4(1): 23. 1949. — *Lectotype*: [Myanmar] Burma. Myitkina District, Tagwin Chaung, evergreen forests, 400 ft, 24 Nov. 1928, *C.E. Parkinson 1761* (K!). (*Lectotype* designated by Liu *et al.*, Bot. Bull. Acad. Sin. 43: 79 [2002]).

***Musa itinerans* var. *formosana* (Warb.) Häkkinen & C. L. Yeh, **comb. nov.** Figs. 1 & 3–5.**

Basionym: *Musa ×paradisiaca* L. subsp. *seminifera* (Lour.) Baker var. *formosana* Warb., Pflanzenr. (Engler) IV.45: 21 (1900). — *M. formosana* (Warb.) Hayata, Icon. Pl. Formosan. 6(Suppl.): 83 (1917); *M. basjoo* Inuma var. *formosana* (Warb.) S. S. Ying, Mem. Coll. Agr. Natn. Taiwan Univ. 25: 100 (1985). — *Neotype*: Taiwan [Formosa], Uchiko, Yusuikyo, 17 Sept. 1916, *B. Hayata s.n.* (TI!). (*Neotype* designated by Häkkinen & Väre, Adansonia 30(1): 88 [2008]).

Plant normal, sparsely suckering to 0.3–1 m from parent plant, to 10 suckers, position vertical; mature pseudostem to 2 m high, to 15 cm diam. at base, covered with varying amounts of dead brown leaf sheaths, underlying colour green with red pigmentation, shiny, sap watery (Fig. 3). *Petiole* to 30 cm, petiole canal margins erect, petiole bases winged and clasping the pseudostem with sparse red-brownish blotches. *Leaf* habit intermediate, lamina to 130 × 30 cm, narrowly elliptic, truncate at apex, both sides green, appearance shiny, no wax on either surfaces, leaf bases symmetric, both sides rounded, midrib dorsally green and ventrally light green, with more or less light red-brownish blotches, corrugated lamina. *Inflorescence* semi-pendulous and then falling at an angle, peduncle to 30 cm, to 6 cm diam., densely puberulent with short hairs, pale green to rusty brown, sterile bract 2, bracts persistent at the opening of the first female flowers. *Basal flowers* hermaphrodite, ca. 6 cm, ovary pale green, arrangement ovules in 4 rows per locule; compound tepal ca. 5 cm, with 2 prominent thickened keel; free tepal ca. 2.2 cm, rounded, corrugated, translucent white, apex little development, stamens 5 with fertile pollen, style ca. 4.5 cm, yellow, white stigma ca. 0.3 cm in diam. *Male bud* ovoid, ca. 13 × 7 cm, bracts red externally with a green margin and yellow stripes, shiny yellow internally, without wax, not imbricate, lifting 1 or 2 bracts at a

time, these revolute before falling; male flowers 12–17 per bract in 2 rows, falling with the bract; compound tepal ca. 4.5 cm, yellowish cream with two thickened keels, ribbed at the dorsal angles, with 5-toothed yellowish apex, central lobes smaller than outer lobes, free tepal ca. 1.7 cm long, translucent white, oval, smooth, upper part serrate, stamens 5, filaments white, anthers yellowish, stigma cream, ovary arched, whitish (Fig. 4). *Fruit* bunch lax, with 5–9 hands and 8–12 fruits per hand, in 2 rows, fingers perpendicular to the stalk, individual fruit ca. 7 cm, straight, ridged, pedicel 3 cm, pubescent, fruit apex bottle-necked, without relictual floral remains, immature fruit peel pubescent, whitish-green with red or violet, becoming dull brown-yellow at maturity, immature fruit pulp white, becoming cream to yellow and soft at maturity (Fig. 5). *Seeds* flattened to angular, ca. 6 mm diam., 60–80 seeds per fruit.

Distribution and habitat. Var. *formosana* is distributed over the whole island of Taiwan and its off-shore island, Lanyu, from tropical regions to temperate regions at elevations of 100 to 1300 meters in moist ravines. Its relationship to *M. itinerans* is also supported by the phylogenetic analyses of the banana family (Musaceae) based on nuclear ribosomal (ITS) and chloroplast (*trnL-F*) DNA evidence (Liu *et al.* 2010).

Additional specimens examined. TAIWAN. Chiayi Co.: East of Kagi, 17 Oct. 1912, *W. R. Price 915* (K!). — Nanto Co.: SE of Rinkih, 2 Nov. 1912, *W. R. Price 1058* (K!). — Kaohsiung Co.: Sanmin, 1 Sep. 2006, *C. L. Yeh & C. R. Yeh s.n.* (PPI!). — Pingtung Co.: Chingshan, 3 Sep. 2006, *C. L. Yeh & C. R. Yeh s.n.* (PPI!); Peitawushan, 22 Jul. 2006, 12 Sep. 2006, *C. L. Yeh & C. R. Yeh s.n.* (PPI!); Wanan, 22 Jul. 2006, 1 Mar. 2007, *C. R. Yeh s.n.* (PPI!); Laisheshan, 21 Jan. 2005, 11 Aug. 2006, 15 Sep. 2006, *C. R. Yeh s.n.* (PPI!); Shoka, 16 Nov. 2006, *C. R. Yeh s.n.* (PPI!); Shehai, 24 Nov. 2006, *C. L. Yeh & C. R. Yeh s.n.* (PPI!). — Ilan Co.: Nanou, 17 Jan. 2007, *C. R. Yeh & C. W. Hong s.n.* (PPI!). — Taitung Co., Lanyu Isl.: Jung-Ai Bridge, 21 Feb. 2007, *C. R. Yeh & C. W. Hong s.n.* (PPI!); Tienchi, 23 Feb. 2007, *C. R. Yeh & C. W. Hong s.n.* (PPI!).

Note. The main herbarium and types by Otto Warburg are at B (Stafleu & Cowan 1988). However, such a collection could not be found. In his combination, Ying (1985) wrongly assigned the

authorship to Siebold (1830). The neotype specimen represents *M. itinerans*, and the diagnosis by Warburg: “Bractae parvae lanceolatae acutae tepalo libero acuto” fits *M. itinerans*, like most other *Musa*.

***Musa itinerans* var. *hainanensis* Häkkinen & X. J. Ge, var. nov.** Figs. 3 & 6–8.

Planta mediocris, frequenter cum usque 5 sparsis surculis erectis, 0.5–2 m a praecipuo caule remotis; caulis maturus usque ad 4.0 m altus; succo lacteo. Inflorescentia pri-

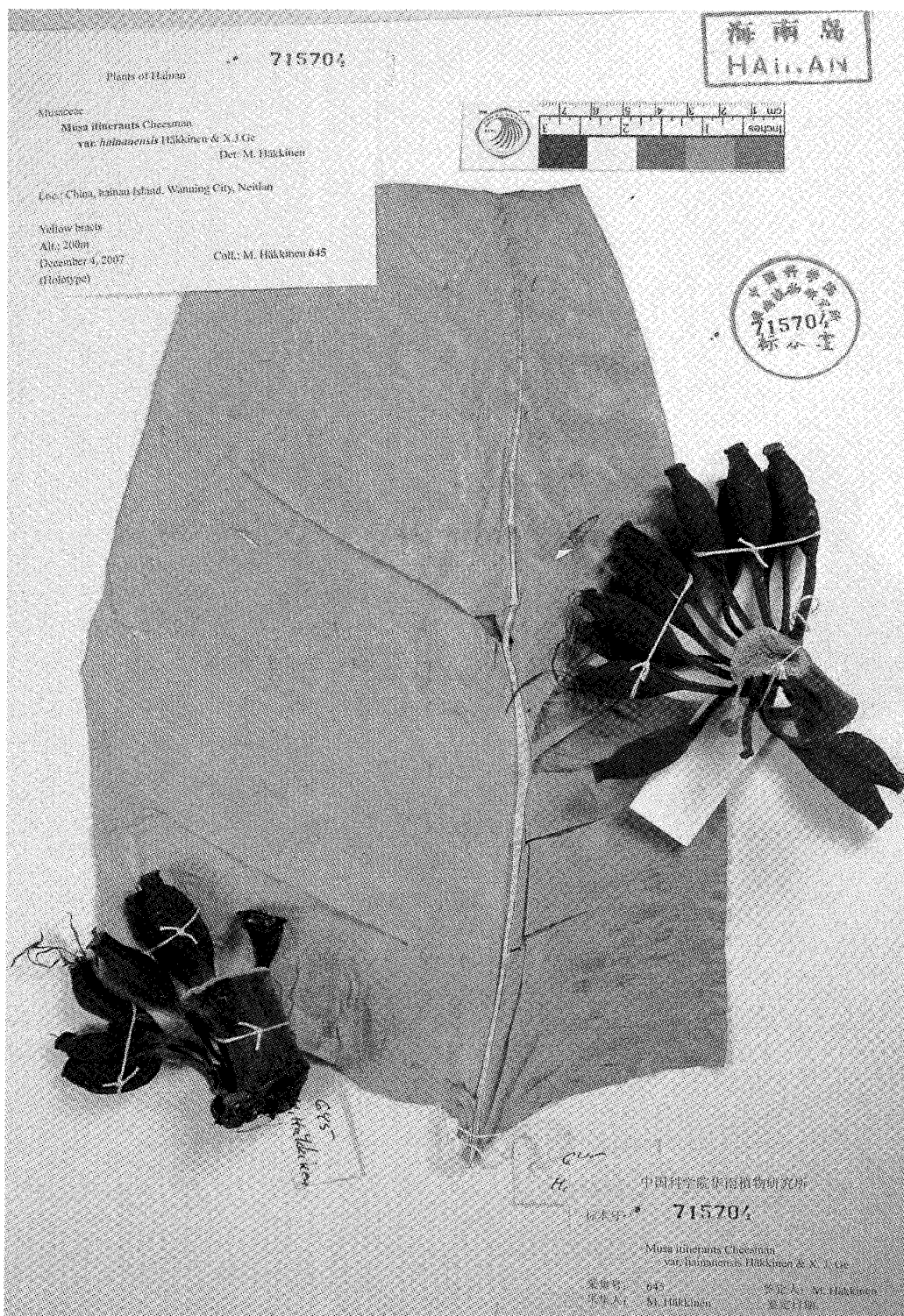


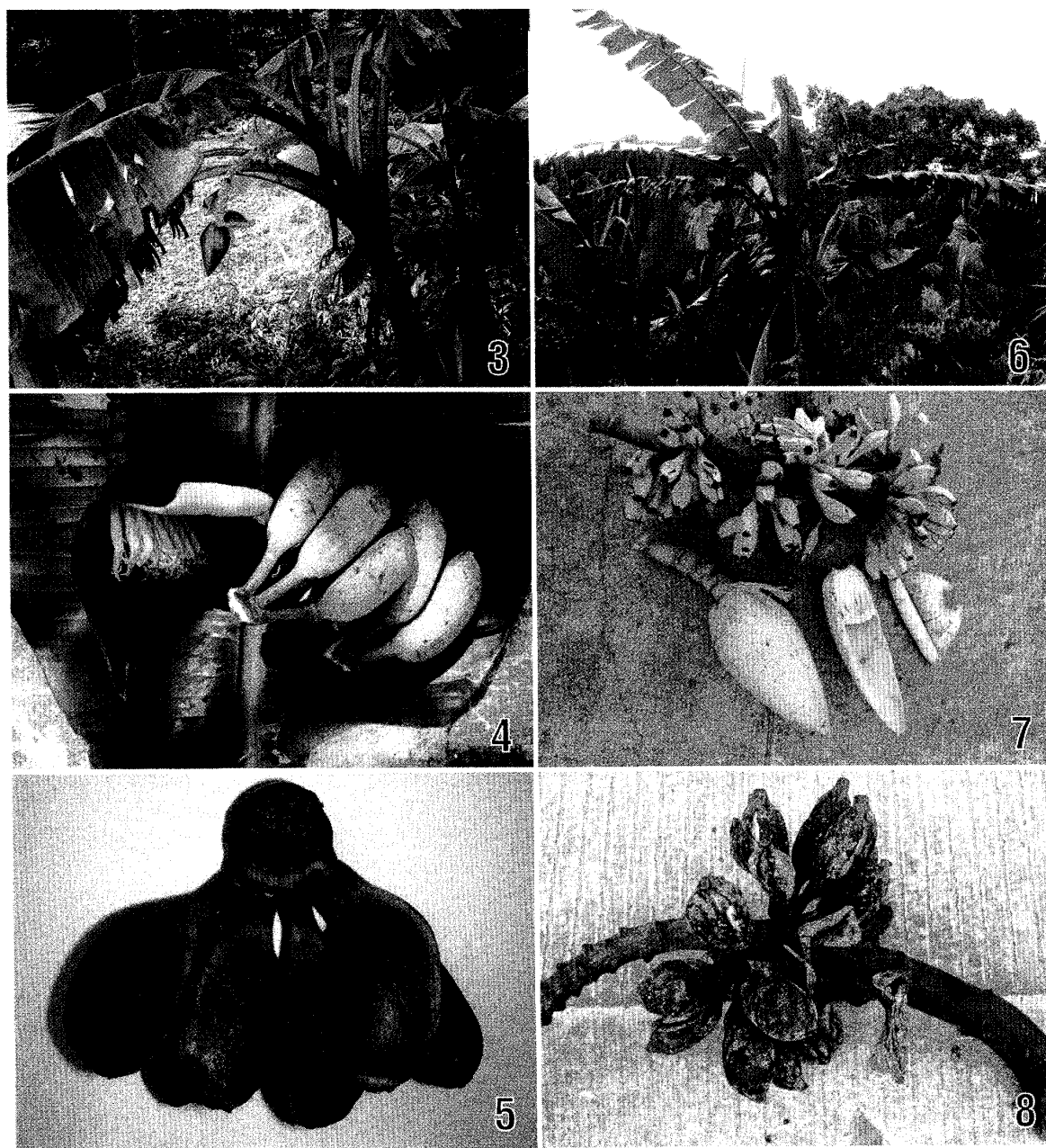
FIG. 2. *Musa itinerans* var. *hainanensis* Häkkinen & X. J. Ge. Holotype, *M. Häkkinen* 545 (IBSC). Photo by Zeng Feiyan.

mo horizontalis, deinde omnino cadens; flores feminei basales cum ovulis 4-seriatis in quoque loculo; masculinum alabastrum bracteis flavis pallidis utrinque viridescentibus, nullo modo imbricatis.

Infrutescentia laxa; fructus digitiformes perpendiculares a pedunculo, unusquisque ca. 6.5 cm longus, stric-tus rotundatus, pedicello ca. 4.5 cm longo, pericarpio primo viridi pallido, ad maturitatem nigro obscuro atque longistrorsum findenti. Semina 80–100 in quoque fructu, paene plana, caperata, ca. 3.5 mm in diametro.

Typus. CHINA. Hainan, Wanning City, Neitian, 200 m. 4 Dec. 2007, *M. Häkkinen* 645 (holo IBSC!; iso- H!, MO!).

Plant normal, sparsely suckering in many instances, to 0.5–2 m from parent plant, up to 5 suckers, position vertical; mature pseudostem to 4.0 m high, 20 cm in diam. at base, covered with varying amounts of dead brown leaf sheaths, un-



FIGS. 3–8. *Musa itinerans* var. *formosana* (3–5) and var. *hainanensis* (6–8). 3. Plant and inflorescence. Taiwan, Taipei Co., Wulai. Photo by C.-L. Yeh. 4. Male bud and unripe fruits. Taiwan, Kaohsiung Co., Sanmin. Photo by C.-L. Yeh. 5. Mature fruits. Taiwan, Pingtung Co., Chingshan. Photo by C.-L. Yeh. 6. Plant and inflorescence. China, Hainan Island. Wanning City, Neitian. Photo by X.-J. Ge. 7. Male bud and unripe fruits. China, Hainan Island. Baishan County, Fulong. Photo by X.-J. Ge. 8. Mature fruits. China, Hainan Island. Changjiang County, Bawalling Nature Reserve. Photo by M. Häkkinen

derlying color light green with large black blotches, shiny, sap milky (Fig. 6). *Petiole* to 40 cm, petiole canal open with margins spreading, petiole bases not winged and clasping the pseudostem with sparse black blotches. *Leaf* habit erect, lamina to 250 × 50 cm, narrowly elliptic, truncate at the apex, adaxially dark green, abaxially green, appearance shiny, without wax on either surfaces, leaf bases asymmetric, both sides rounded and auriculate, midrib dorsally green and ventrally light green, with very corrugated lamina. *Inflorescence* at first horizontal and then falling vertically downwards, peduncle to 25 cm, to 4 cm diam., densely puberulent with short hairs, green to rusty brown, sterile bracts 2, bracts deciduous at opening of the first female flowers. *Basal flowers* female, ca. 7 cm, ovary pale green, arrangement of ovules in 4 rows per loculus; compound tepal ca. 5 cm, with 2 prominent thickened keels; free tepal ca. 2.5 cm, rounded, corrugated, translucent white, apex little development, stamens 5 without fertile pollen, style ca. 4.5 cm, yellow, white stigma ca. 0.3 cm in diam. *Male bud* ovoid, ca. 12 × 7 cm, bracts pale yellow in both sides tinted with green, dull, not imbricate, lifting one bract at a time, these revolute before falling, soon deciduous; male flowers on average 17 per bract in 2 rows, falling with the bract, compound tepal ca. 4.8 cm, pale yellow to orange with 2 thickened keels, ribbed at the dorsal angles, with 5-toothed orange apex, central lobes smaller than the outer lobes, free tepal ca. 2.2 cm, translucent white, ovoid, smooth, with thread-like apex, stamens 5, filaments white, anthers cream, anthers and style inserted; stigma cream; ovary arched, light green Fig. 7. *Fruit* bunch lax, with 9 hands and 15 fruits per hand on average, in 2 rows, fingers perpendicular to the stalk, individual fruit ca. 6.5 cm, straight, rounded, pedicel ca. 4.5 cm, pubescent, fruit apex bottle-necked, without relictual floral remains, immature peel color pale green, becoming dull black and splitting lengthwise at maturity, immature fruit pulp white, becoming cream to yellow and soft at maturity (Fig. 8). *Seeds* flattened to angular, ca. 3.5 mm diam., 80 to 100 seeds per fruit.

Distribution and habitat. Hainan Island is located at the southernmost part of China belonging to the tropical region. The wild banana populations occur in the center mountainous area of the island in fertile mountain valleys and ravines, which divide the island from west to east. All the observed and studied wild bananas were *Musa itinerans* varieties viz. var. *chinensis*, var. *guangdongensis* and var. *hainanensis* which were in some places growing sympatrically. However, no clear hybrids could be observed in those populations and in those four observed locations for var. *hainanensis*. McClure (1921) reported in his herbarium sheet label at IBSC: “that the heart of this wild banana plant is eaten by the Loïs as vegetable”. “I have tried it and it is quite palatable, provided, it has the stringy fibres removed and is cooked with some fat”.

Additional specimens examined. CHINA. **Hainan.** Nodda, Yau Ma Wo, 11–20 Nov. 1921, *F. A. McClure* 7995 (K!, IBSC!); Sha Po Ling, 11–20 Nov. 1921, *F. A. McClure* 8185, 8204 (IBSC!); Five Finger Mt., 20 Dec. 1921, *F. A. McClure* 8715, *F. A. McClure* 9497 (IBSC!); Paak Po Shan, 1 Sep. 1927, *Tsang, Wai-Tak* 16223 (K!); Sha Po Shan, 29 May 1928, *Tsang, Wai-Tak* (578) L.U. 17327 (K!); Hung Mo San, 8 July 1929, *Tsang and Fung* (447) L.U. 17981 (K!); Dung Ka, 1932–33, *N. K. Chun & C. L. Tso* 43928 (K!); Road southwest from Jiang Fang Ling Reserve, 5 Dec. 2000, collecting team: *M. G. Gilbert* (MO! c/o BM), *Y. Deng* (IBSC!), *Z. Li* (IBSC!), *N. Thurland* (MO!), *S. Ye* (IBSC!), *N. Xia* (IBSC!) & *Y. Zheng* (IBSC!) 5790468 (MO!); Changjiang Co., Bawangling Nature reserve limestone tropical forest, *M. Häkkinen* 648 (IBSC!).

Conclusion

Two additional varieties of *Musa itinerans* viz. var. *formosana* which proposed a new combination and var. *hainanensis* described herein as new variety have been studied by the authors. Six distinct varieties are already described earlier viz. var. *annamica*, var. *chinensis*, var. *guangdongensis*, var. *itinerans*, var. *lechangensis*, var. *xishuangbannaensis*. It became quite evident during this study that *M. itinerans* is native to southern China, occurs across the Chinese wild banana region, and has evolved into several different forms. However, varieties in countries neighboring China still remain poorly under-

stood and should be subjected to further study. (Häkkinen, pers. obs.).

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